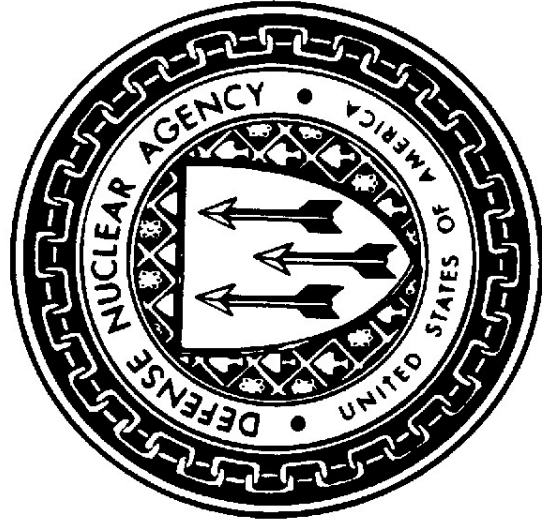


# 32ND

---

## Board of Governors Meeting

### 14 March 84



DNA1.940701.008

0800 - 1100



# THE INTERMEDIATE DOSE PROGRAM

A PROGRESS REPORT

# **CURRENT NUCLEAR RADIATION CRITERIA**

<u>DOSE (RADS)</u>	<u>CASUALTY CRITERIA</u>
18,000	IMMEDIATE PERMANENT INCAPACITATION
8000	IMMEDIATE PERMANENT INCAPACITATION (PHYSICALLY DEMANDING TASK)
3000	IMMEDIATE TRANSIENT INCAPACITATION
650	LATENT LETHALITY

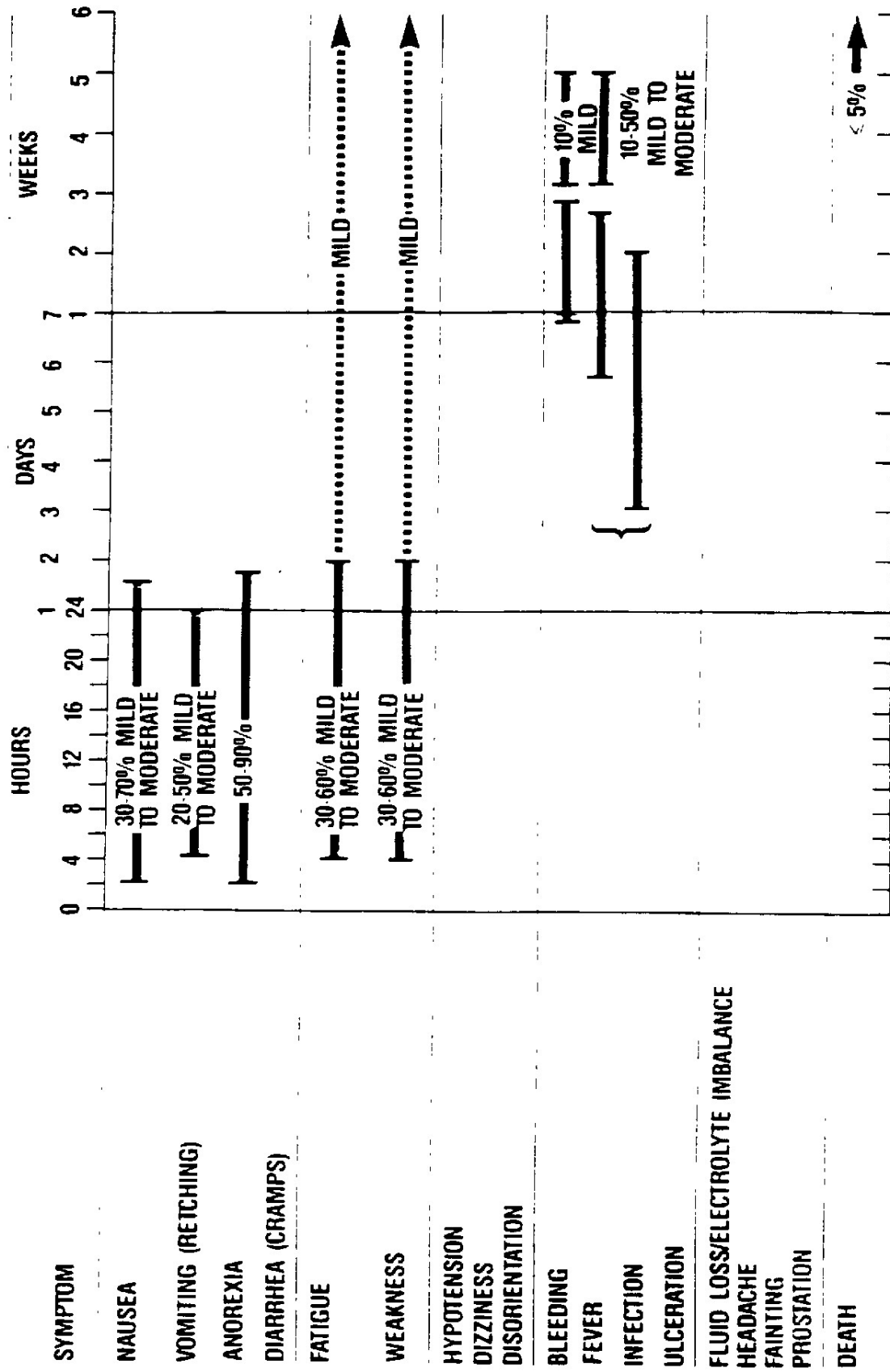
<u>TROOP SAFETY CRITERIA</u>
150 EMERGENCY RISK
70 MODERATE RISK
50 NEGLECTIBLE RISK

# EFFECTS OF PROMPT WHOLE-BODY RADIATIONS ON HUMANS

<i>EFFECT</i>	<i>EXPOSURE DOSE WHICH PRODUCES 50% INCIDENCE (RADS)</i>
LOSS OF APPETITE	170
NAUSEA	250
FATIGUE	260
BLOOD PRESSURE DROP	300
VOMITING	320
DIARRHEA	350
DEATH	450
INCAPACITATION	3000



### POSTEXPOSURE TIME



**1. RADIATION AND SICKNESS**

**2. SICKNESS AND PERFORMANCE**

**3. PERFORMANCE AND EFFECTIVENESS**

## **REPRESENTATIVE COMBAT SYSTEMS**

---

- **INFANTRY — TOW/ITVM901**
  - 54 LB MISSILE, 300 METERS, 16 SEC
  - FOUR CREW MEMBERS
- **ARMOR — M60A3 (M1) TANKS**
  - 30 LBS 105 mm SHELL
  - FOUR CREW MEMBERS
- **ARTILLERY — 155 mm SELF-PROPELLED HOWITZER**
  - 100 LB PROJECTILE
  - BATTALLION-LEVEL FIRE SUPPORT COMPANY
  - GUN + FDC + OP'S + (TACFIRE)

# **SYMPTOM COMPLEXES**

---

UG LG FW CV IB FL

**113121**

**TIRED, WITH MODERATE WEAKNESS; MILD FEVER  
AND HEADACHE; LIKE STARTING TO COME DOWN  
WITH FLU**

**514111**

**VOMITED SEVERAL TIMES INCLUDING DRY HEAVES;  
SEVERELY NAUSEATED AND WILL SOON VOMIT  
AGAIN; VERY TIRED AND WEAK**

# **BACKGROUND**

---

- DAS ● GAO
- KOSLOV ● ADP
- RDA ● 1982 - 83 Review

# USES OF IDP PRODUCTS

## CERTAINLY

- UPDATE DOSE RESPONSE TABLES IN. . .
  - STANAG 2111 (FM 101-31-1)
  - STANAG 2083
  - STANAG 2866
- STANAG 2111 DISCUSSION RELATING INDIVIDUAL PERFORMANCE TO CREW AND UNIT PERFORMANCE
- MODIFICATION OF TARGET DEFEAT/NEUTRALIZATION COVERAGES REQUIRED IN. . .
  - SACEUR SUPPLAN 10001 A
  - COMCENTAG SUPPLAN 33001 A
  - NUCLEAR PLANNING MANUAL, ALLIED COMMAND EUROPE

## POSSIBLY

- MODIFICATION OF CRITERIA IN FM 101-31-2
  - CASUALTIES
  - TROOP SAFETY
  - COLLATERAL DAMAGE

# SAMPLE QUESTION — TOW/ITV

## DESCRIPTION OF ILLNESS:

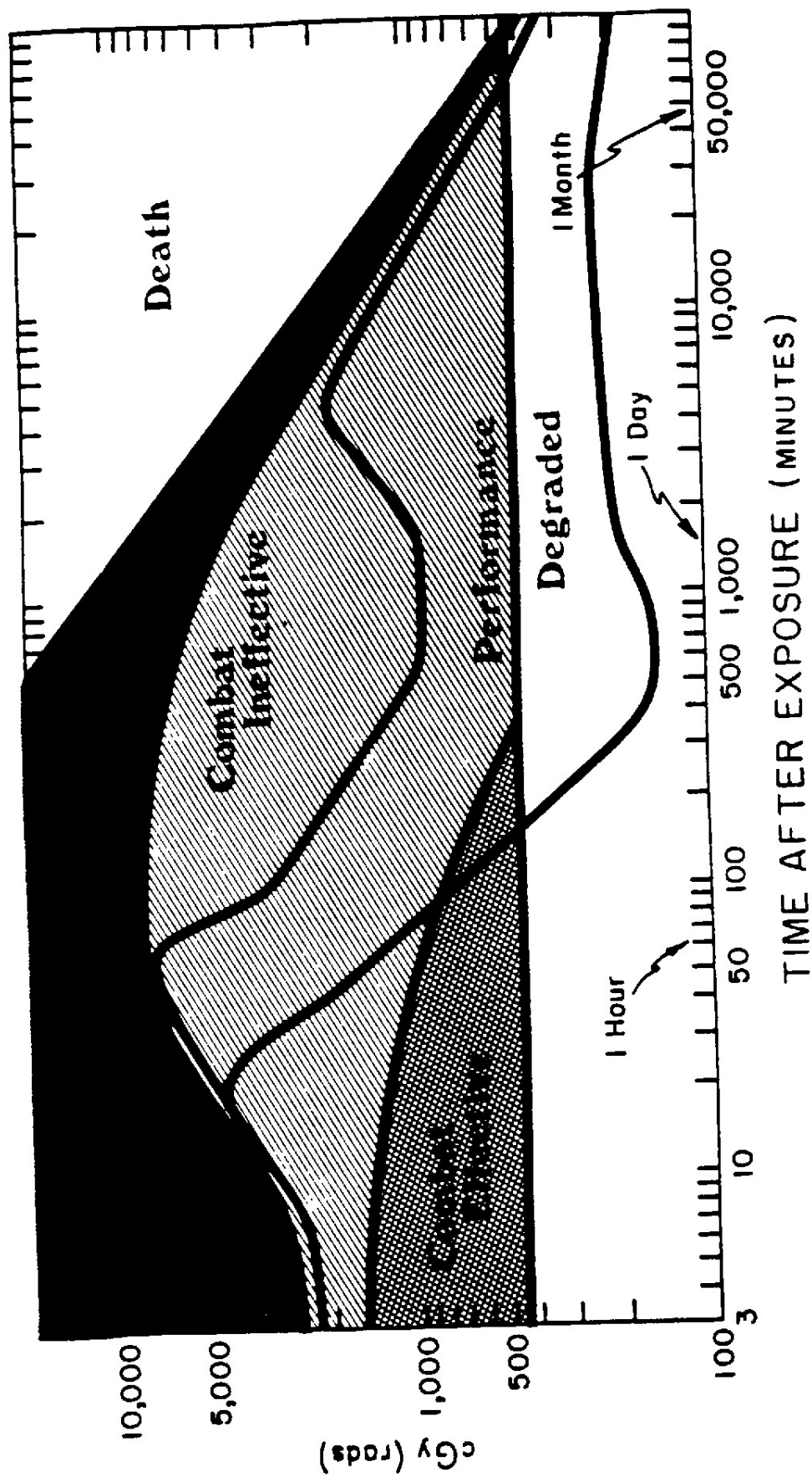
NAUSEATED; CONSIDERABLE SWEATING; SWALLOWS FREQUENTLY TO AVOID VOMITING; OCCASIONAL DIARRHEA AND CRAMPS, DEFECATED SEVERAL TIMES AND WILL AGAIN SOON; VERY TIRED AND WEAK; SLIGHTLY LIGHT-HEADED; JOINTS ACHE, CONSIDERABLE SWEATING; MODERATE FEVER; DOESN'T WANT TO EAT; SORES IN MOUTH/THROAT.

## CREW TASKS

CREW MEMBER/TASKS	THE USUAL TIME FOR EACH TASK IS ABOUT:	HOW LONG DO YOU THINK IT WOULD TAKE A CREWMAN TO DO EACH TASK IF HE HAD THESE SYMPTOMS?		
		NO INCREASE IN TIME	AMOUNT OF TIME (SEC.)	COULD NOT DO IT AT ALL
SQUAD LEADER DESIGNATE AZIMUTH AND TARGET	4 SEC			
COMMAND DRIVER TO FIRING POSITION	2 SEC.			
GUNNER SET SUPERELEVATION, ERECT, SLEW 170° TO 10° AZIMUTH	17 SEC.			
ADJUST MAGNIFICATION, ACQUIRE TARGETS, IDENTIFY, ARM, AND FIRE.	7 SEC.			
DRIVER FROM STANDSTILL, DRIVE FORWARD 40 FT. AND STOP	20 SEC			
LOADER RELOAD	60 SEC.			
REARRANGE READY RACK	60 SEC			

# EXPECTED RESPONSE TO RADIATION

( PHYSICALLY DEMANDING TASKS )





# BEHAVIORAL SCIENCES

---

- Analysis
- Temporary Action
- Appointment of Chairman

# **PEER REVIEW PROCESS**

---

- **Reviewer Selection**
- **Reviewer Briefing**
- **Interviewers**
- **Reports**

# **RADIATION DOSIMETRY**

---

- Analysis
- Actions
  - Personnel
  - NBS Collaboration

# **ROLE OF MILITARY SCIENTISTS**

---

- Selection
- Research Assignments
- General Training

# **FACILITATING DEPARTMENTS**

---

## **COMPUTER & ELECTRONICS (CED)**

- ADP
- Electronics
- Statistics

## **VETERINARY MEDICINE (VMD)**

- Head
- AAALAC
- Peer Review

## **LOGISTICS & ENGINEERING (LOG)**

- New Leadership

# **GENERAL SCIENTIFIC AIDS**

---

- Scientific Leadership
- Technical Support
- Space Utilization

# **ACCOLADES**

---

- **Protection**
- **Drugs and Radiation**
- **Combined Injury**
- **Cellular Biology/Spectroscopy**
- **Neuro and Gastric Physiology**

# **ACCOMPLISHMENTS**

## **PROGRAM REVIEW**

- **Required Program Review**
- **Program Review Agenda**
  - **Research Milestone**



# **ACCOMPLISHMENTS**

## **PERSONNEL**

- **DoD Manpower Instability**
- **DNA Biomedical Requirements**
- **Scrub all Billets**

# ACCOMPLISHMENTS

## RETREAT

- *Where are we now?*
- New Directions
  - DEW
  - Man in Space
  - Nuclear Winter
  - Radiogenic Cancer
  - Education

# **Military Radiobiology Research Requirements Through The Year 2000**

---

## **RESEARCH REQUIREMENTS:**

- Present Status (Program Review; Personnel Review)
- New Directions
- Requirements to accomplish relevant research
  - Personnel
  - Facilities
  - Equipment
  - Contracts
  - Technologies

# **Military Radiobiology Research Requirements Through The Year 2000**

---

## **NEW DIRECTIONS:**

- **Man in Space**
- **Directed Energy Weapons**
- **Radiation - Cancer**
- **Nuclear Winter**
  - **Biological effects**

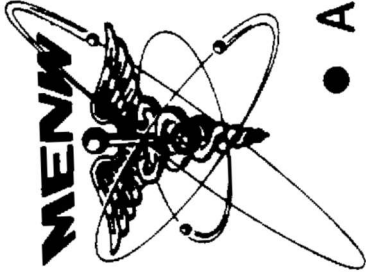
# **ACCOMPLISHMENTS**

## **REQUIREMENTS**

- **Personnel**
- **Facilities**
- **Equipment**

# **Relicensing of AFRRI Reactor and Radiation Sources Upgrade**

- Reactor and Cobalt Facility License still before Nuclear Regulatory Commission Relicensing Board
- Electron Linear Accelerator is being modernized with computer-assisted controllers
- Consideration being given to high LET source capability



## **Medical Effects of Nuclear Weapons Education Program**

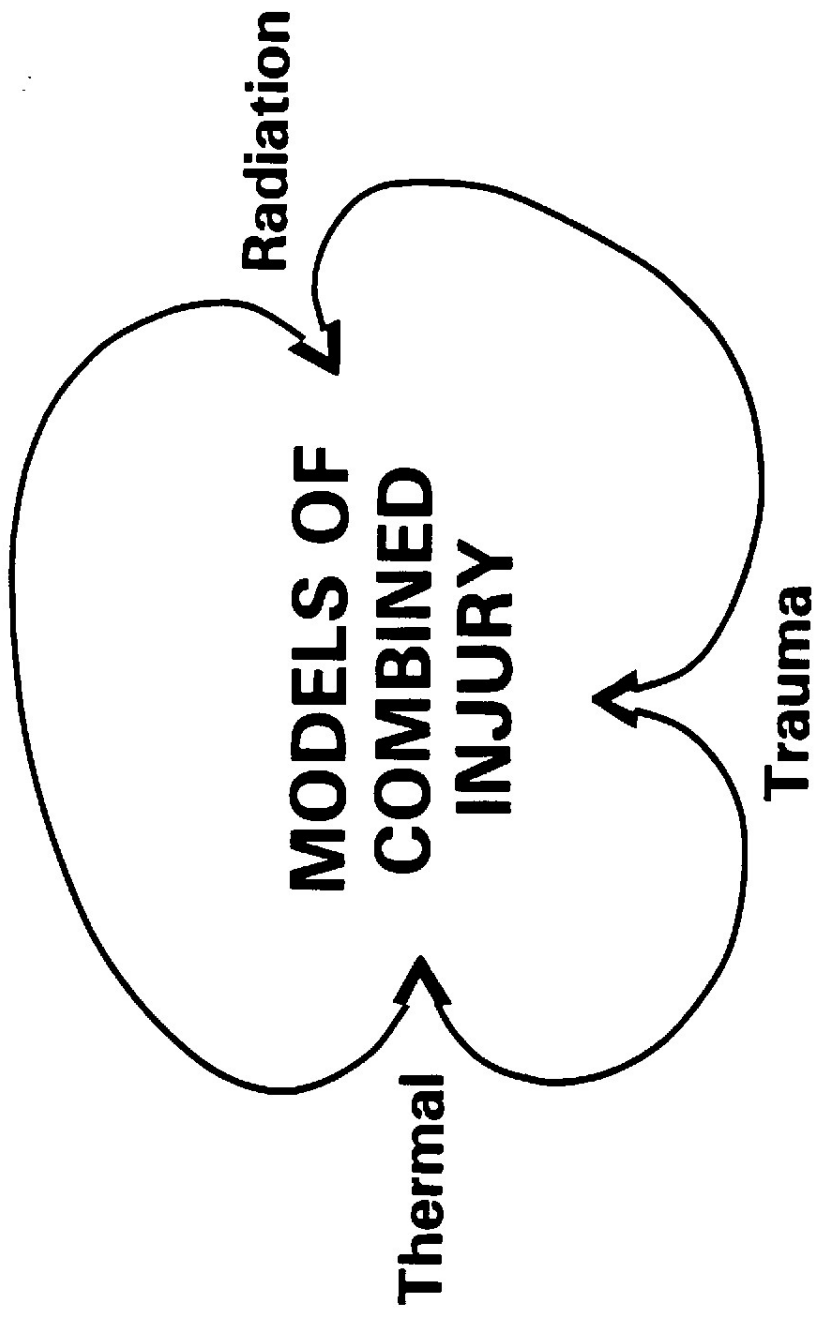
- AFRRI Resident Course (three times annually)
- Pacific and Europe (annually)
- Reserve Medical Commands (as requested)
- Uniformed Services University of the Health Sciences
- Other Federal and Civilian Organizations (as requested)
- Integration of DoD Training for Biomedical Effects of Nuclear Weapons

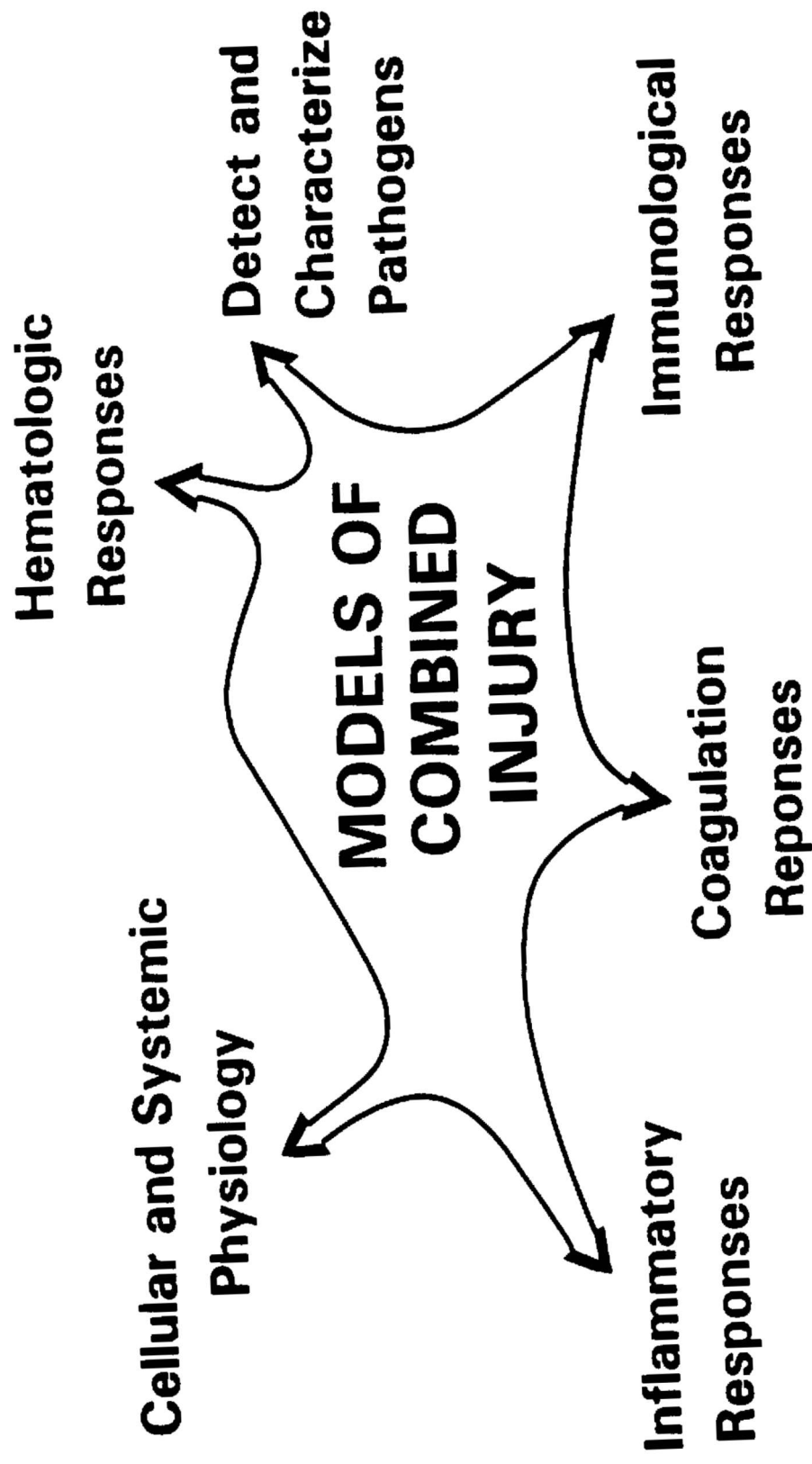
# **First International Symposium on Pathophysiology of Combined Injury and Trauma**

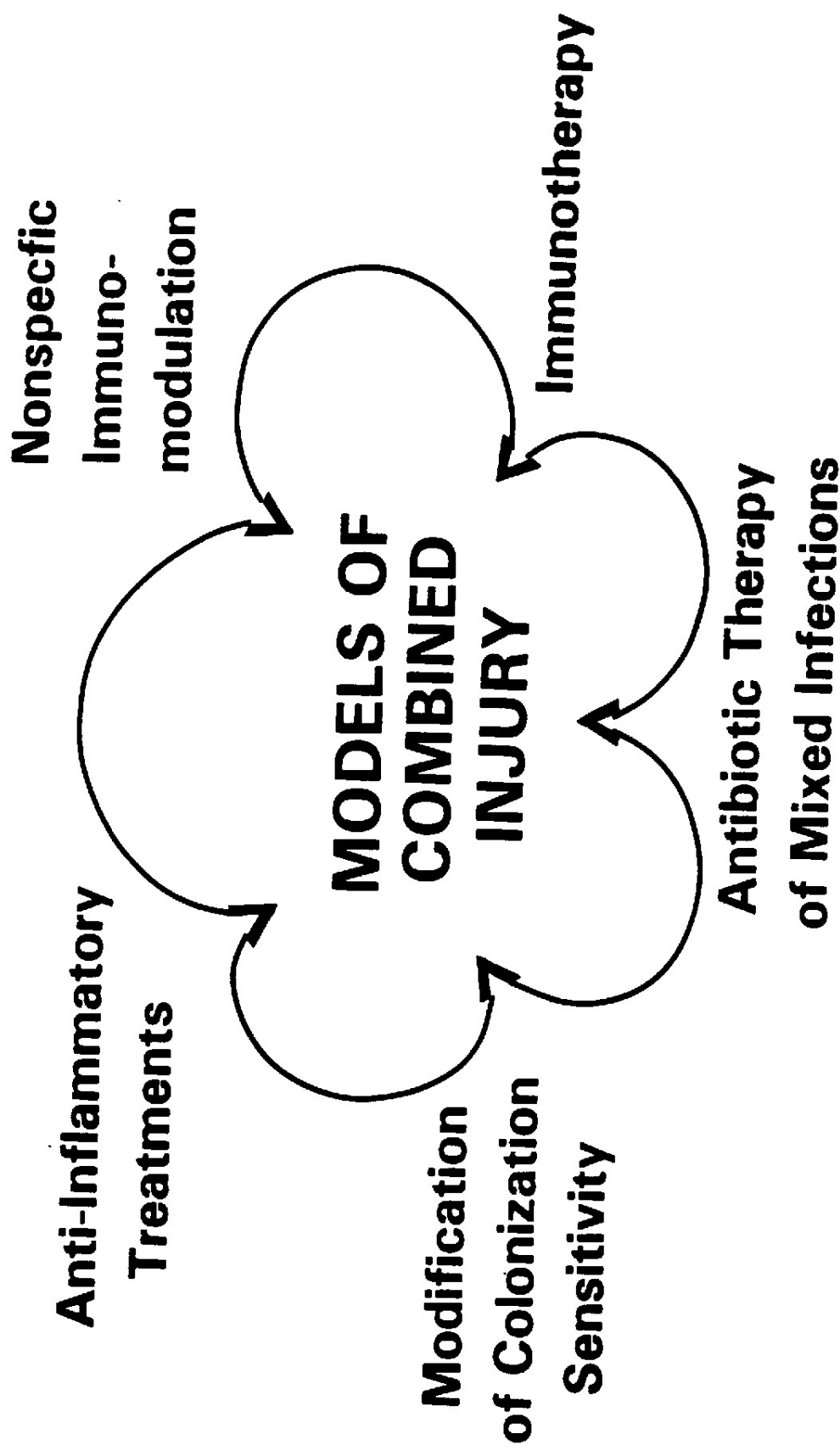
---

- 27 - 29 April 1983
- Sponsored by AFRRRI
- Held at Uniformed Services University of the Health Sciences
- Plenary sessions include:
  - Combined Injury and Trauma*
  - Sepsis*
  - Immunological and Inflammatory Processes*
  - Surgery and Wound Healing*
  - Therapy*
- Round Table Discussion of Therapy; Recommendations for U.S. Forces Medical Personnel
- Proceedings in press
- AFRRRI & USAMRICD









# **THERAPEUTIC INTERVENTIONS**

- THERAPY
  - ANTIBIOTICS
  - VACCINATIONS
  - IMMUNOGLOBULINS
  - BIOLOGICAL RESPONSE MODIFIERS
  - FLUIDS
  - BLOOD PRODUCTS
  - BONE MARROW TRANSPLANTATION
  - ANTIEMETICS
- OPERATIONAL CONSTRAINT
- MEDICAL CONSTRAINT
- STATE OF KNOWLEDGE
- COST

**AFRRI  
MILCON 84**

**PHASE I**  
BHS  
VMD

**PHASE II**  
RSD  
LOG

**PHASE V**  
RSD  
PHY  
EXH  
LOG

**PHASE III**  
BIC  
RSD  
DIR  
LOG (RECV)

**BLD  
42C**

**BLD  
42A**

**BLD 46**

**PHASE I**  
PHY  
BHS  
BIC  
ADM  
OSH  
LOG

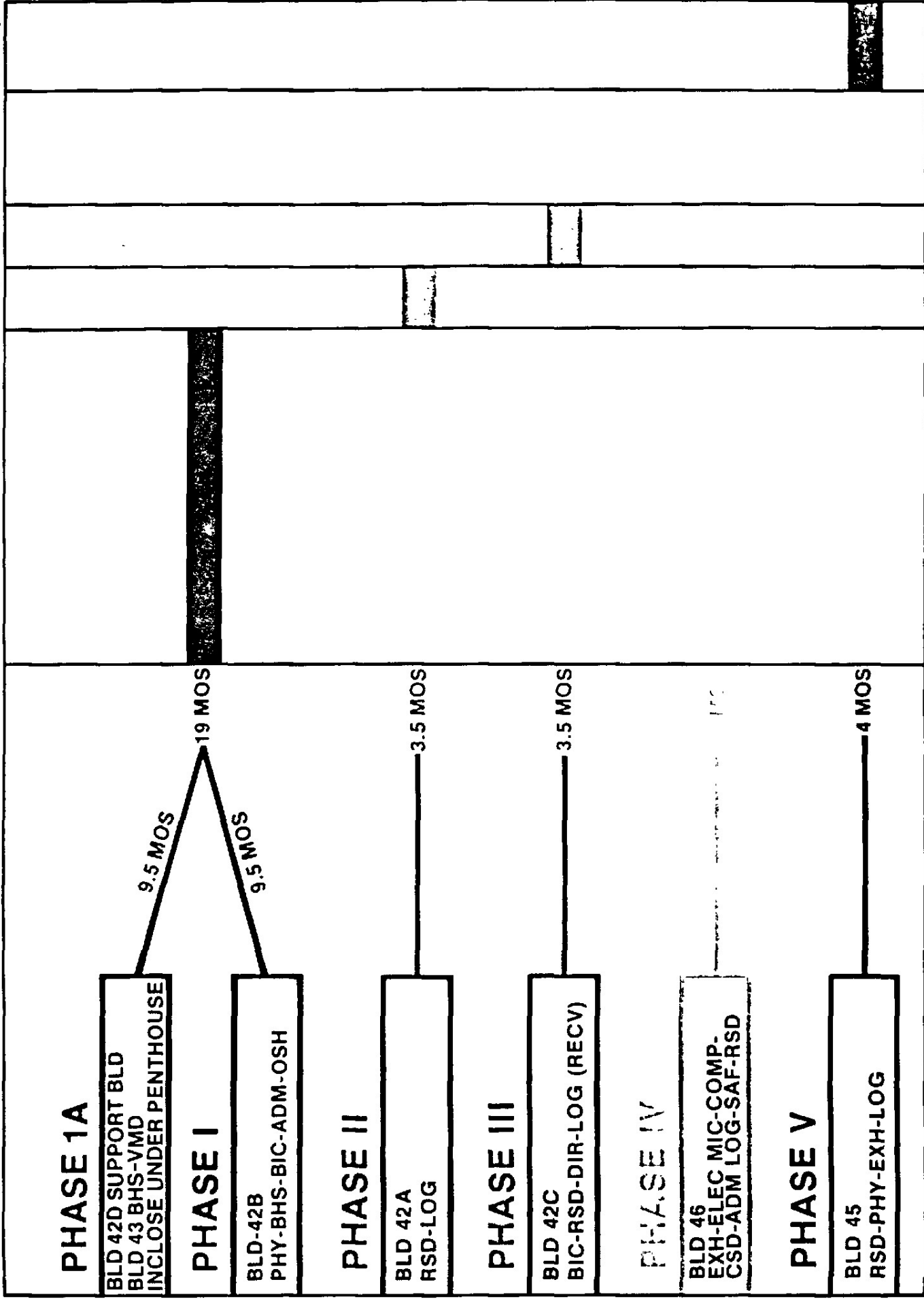
**EXH  
ELECTRON MICROSCOPE  
COMP  
CONF RM  
CSD  
ADM  
LOG  
SAF  
RSD**

# AFRRI - 30 DAYS AFTER CONTRACT AWARD CONSTRUCTION CAN START

## MILCON 84

### EST AWARD DATE MID JUNE '84

0-570 DAYS 585-690 705-810 DAYS 990-1,100 DAYS



# **ISSUES**

- **MILCON 84-89**
  - **Start Outside - August 84**
  - **Start Inside - August 85**
  - **Ampitheater/Parking**

# **ISSUES**

- **Military Research Associateship Program**
- **Change Degree Level of Participants**
- **Physics, Biological and Medical**
- **Numbers per Year**
- **MOU's (LLL, LANL, SANDIA)**



# **ISSUES**

- NTPR
  - Back on Track
  - Won't be Going Away
  - Compensation Bill

# **ISSUES**

- Public Health Services Billets
- Fourth Uniformed Service
- Stability
- NIH, Fertile Recruiting Ground
- Original Charter

# **RADIATION PROTECTION FOR MAN IN SPACE:**

---

**MITIGATION TECHNIQUES**

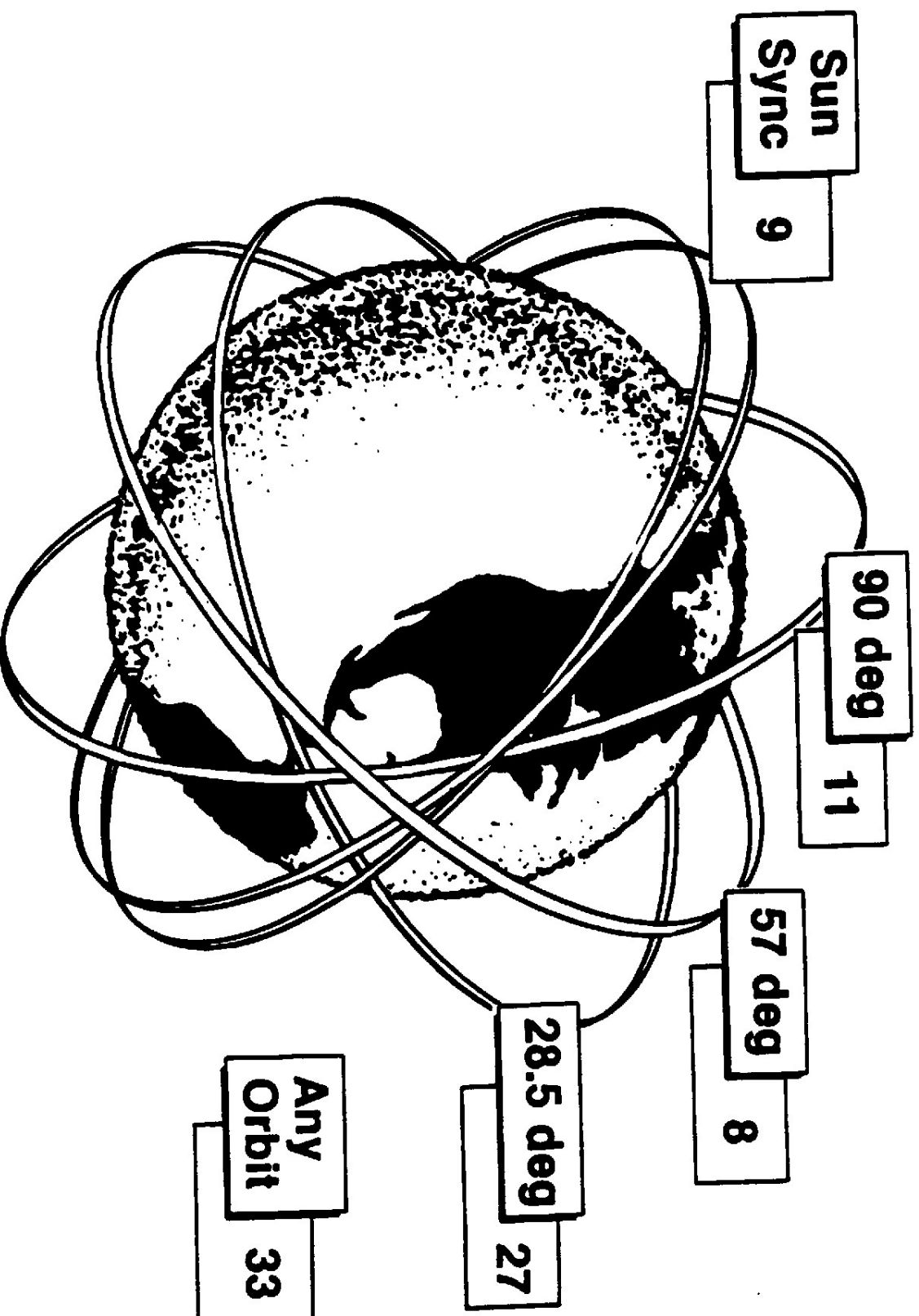


# **SPACE RADIATION ENVIRONMENT**

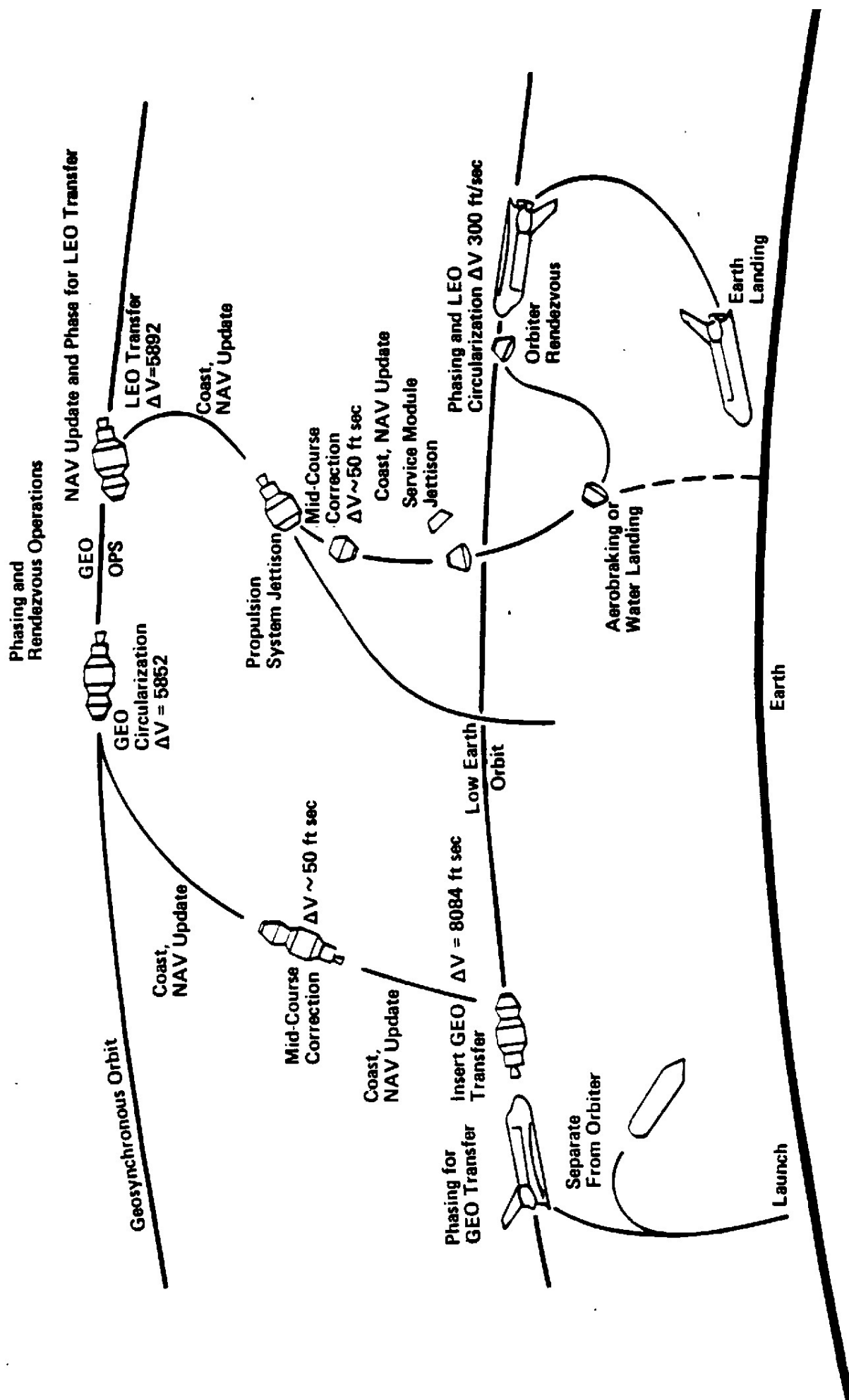
---

- **ARTIFICIAL**
- **SOLAR PARTICLE EVENT**
- **GEOMAGNETICALLY TRAPPED**
- **SP-100 NUCLEAR REACTOR**
- **GALACTIC COSMIC RADIATION**

# ORBIT REQUIREMENTS—ALL MISSIONS

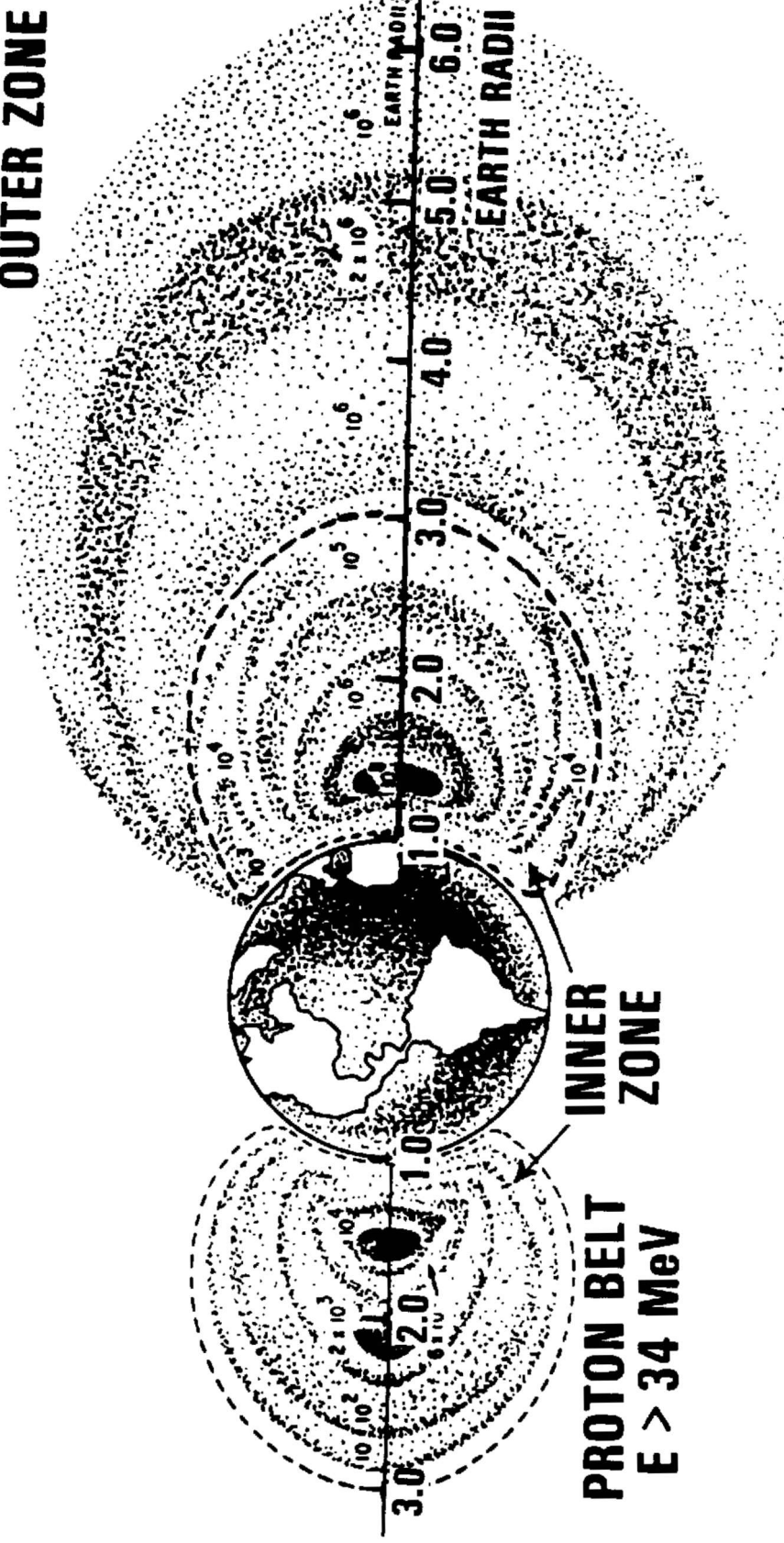


# MANNED GEO SORTIE



# TRAPPED RADIATION ZONES

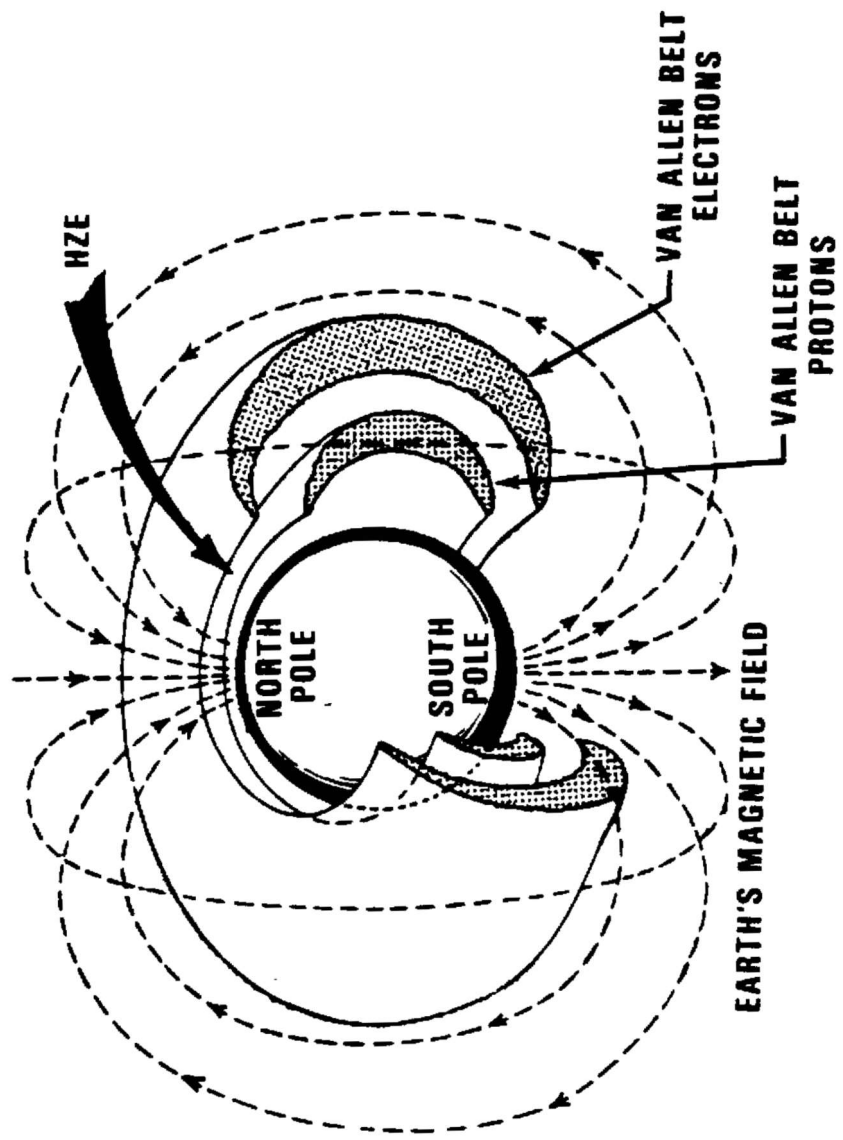
OUTER ZONE



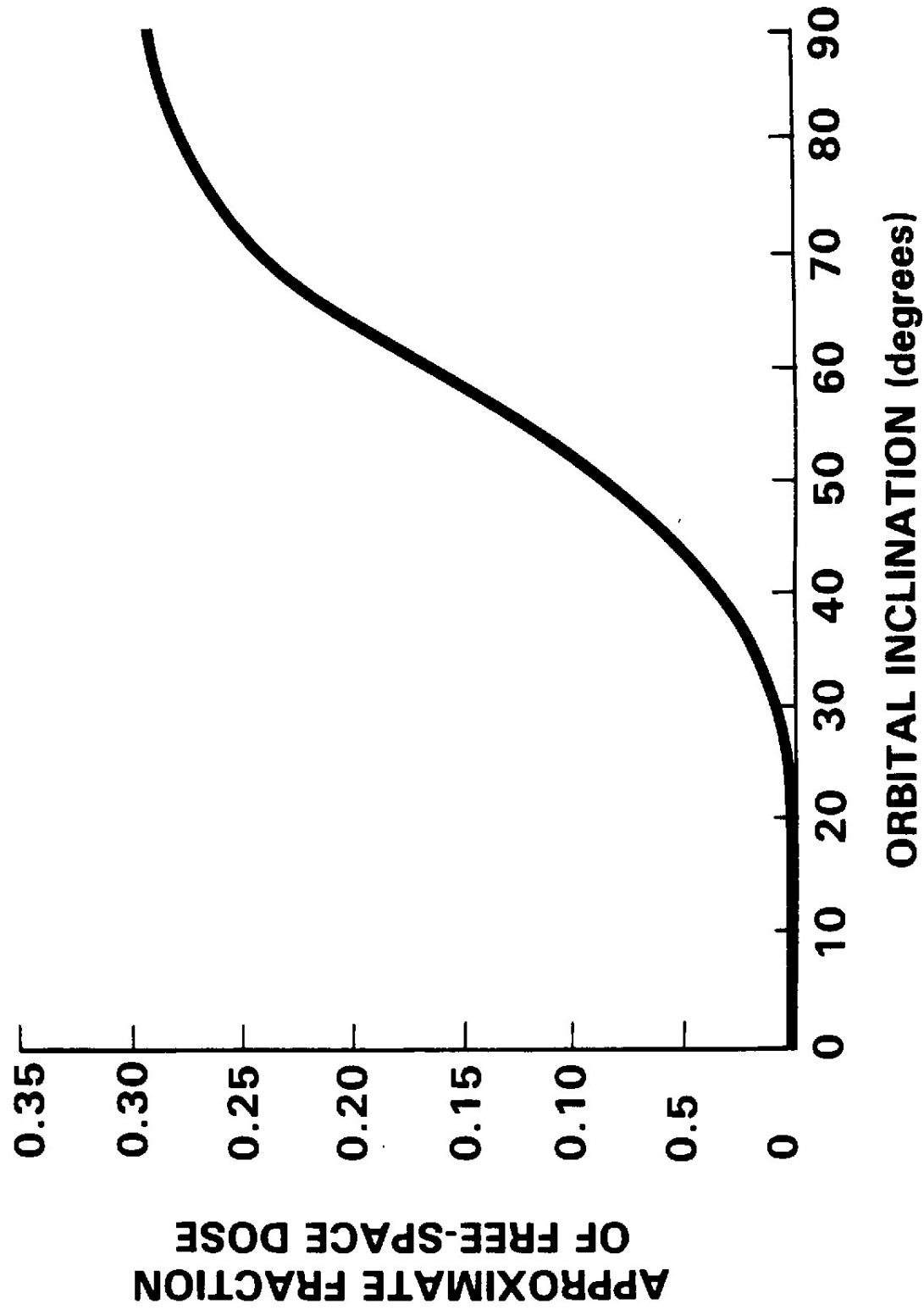
ELECTRON BELT  
 $E > 0.5$  MeV



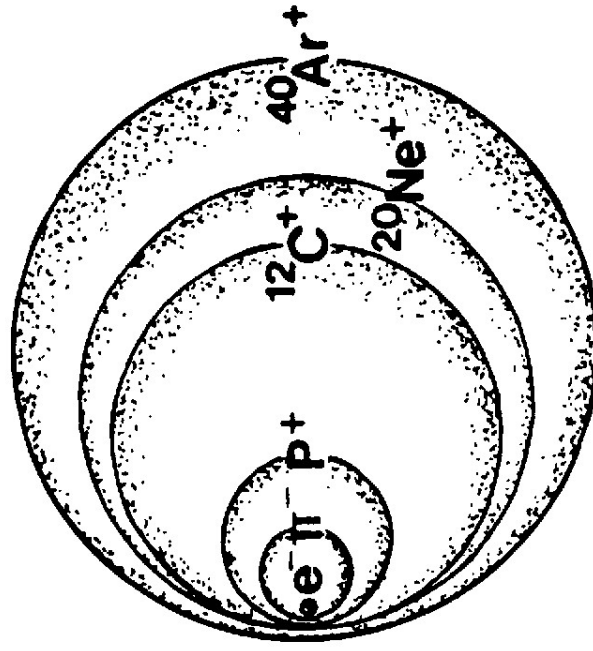
# VAN ALLEN BELTS



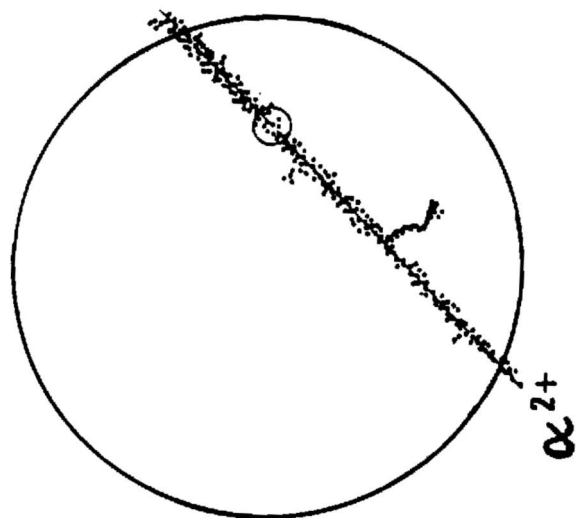
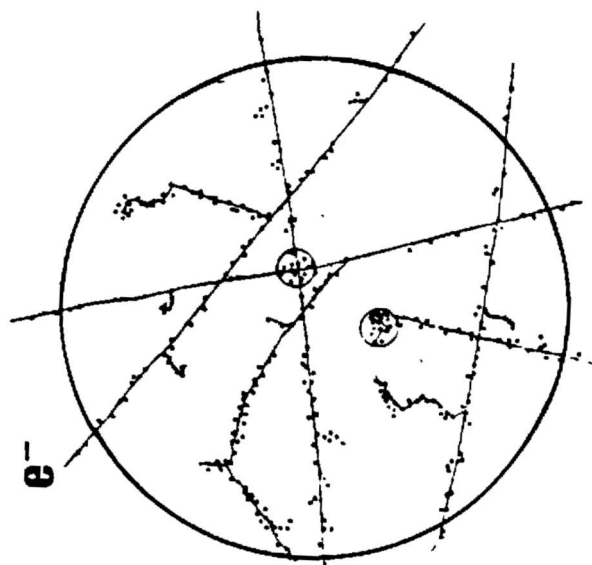
# VARIATION OF SOLAR PROTON DOSE WITH CIRCULAR ORBIT INCLINATION

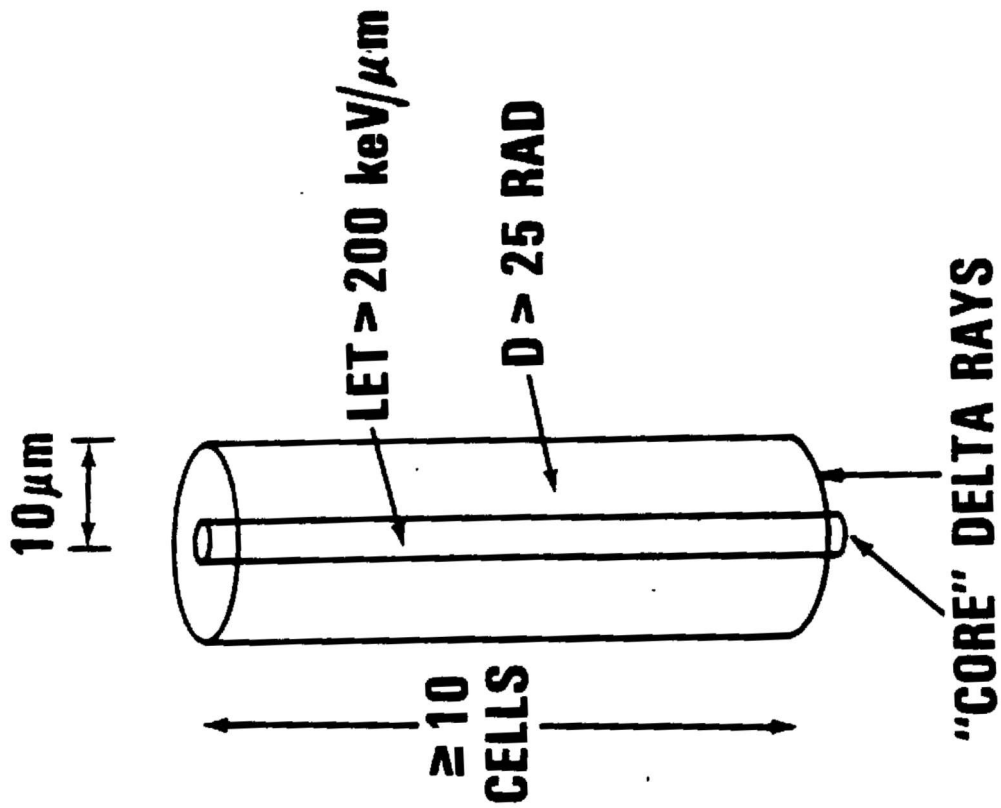


# MASS AND CHARGE OF PARTICLES SPACE RADIATION ENVIRONMENT



# COMPARISON OF LOW AND HIGH LET

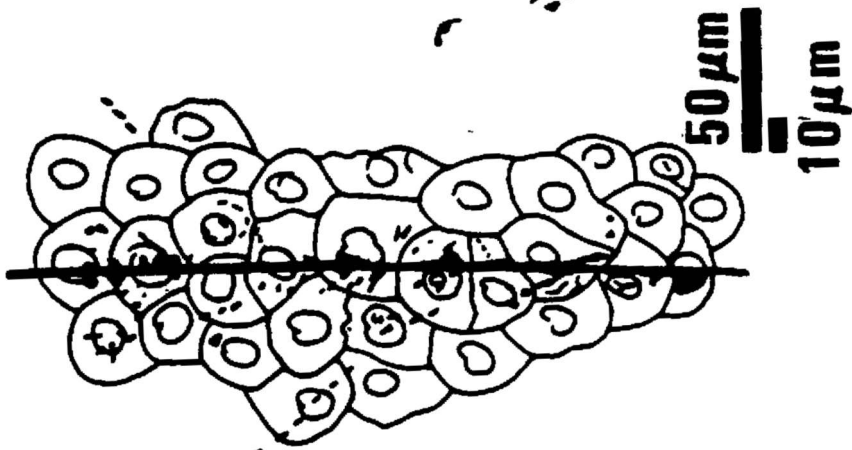




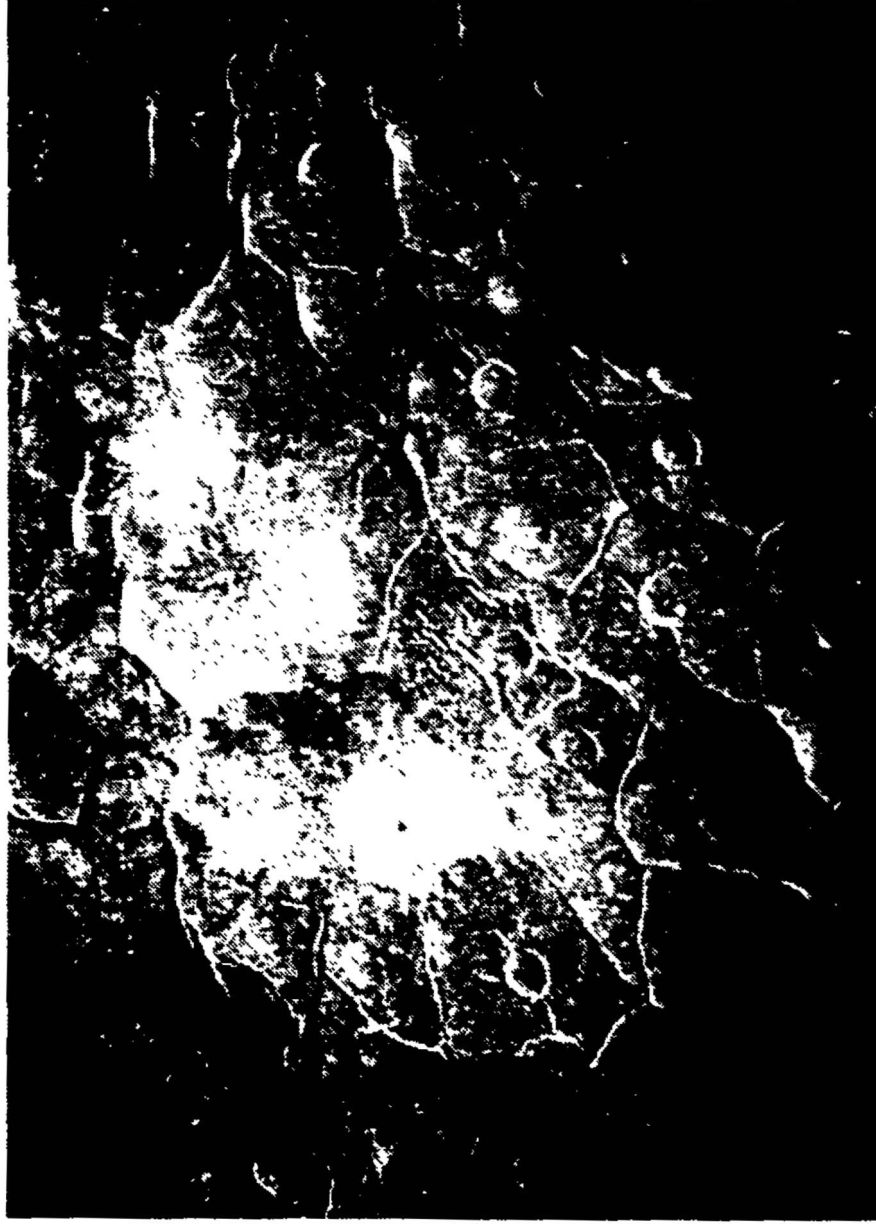
Z-90



Fe, Z-26



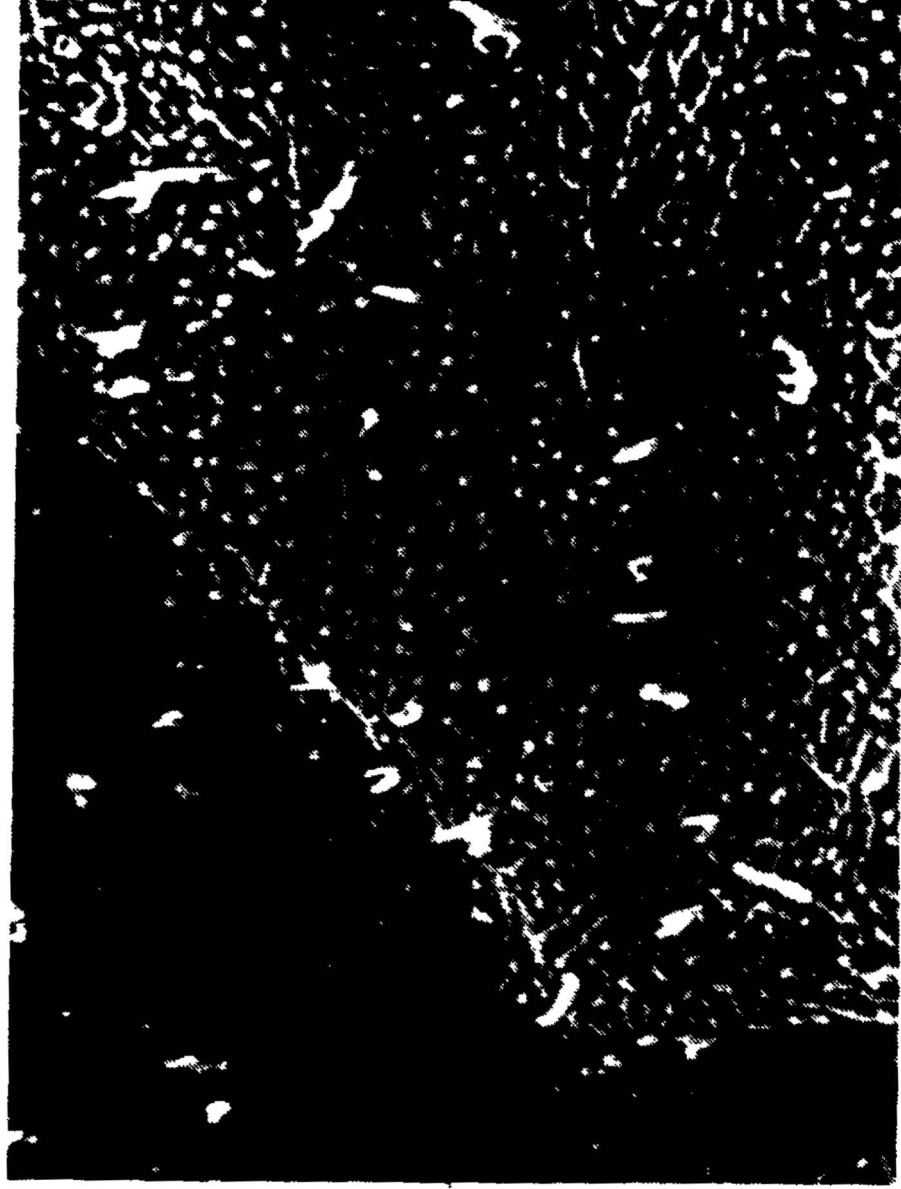
## SEM MICROGRAPH OF ADULT RAT CORNEAL EPITHELIUM



20  $\mu\text{m}$

Cell nuclei bulge at the surface with diameters of 8 to 10  $\mu\text{m}$ . The cell diameters range from 30 to 40  $\mu\text{m}$ . This is a control sample.

**SEM MICROGRAPH OF CORNEA IRRADIATED WITH  
600 MeV/amu IRON PARTICLES**



1  $\mu\text{m}$

The lesion diameter is 0.8  $\mu\text{m}$ .

**SEM MICROGRAPH OF CORNEA IRRADIATED WITH  
3 MeV/amu ARGON PARTICLES**



20  $\mu\text{m}$

Lesion diameters measure 5  $\mu\text{m}$ . Note the relative size of nuclei and whole epithelial cells compared to the heavy ion lesions.



# IONIZING RADIATION IN SPACE

<u>NAME</u>	<u>CHARGE (Z)</u>	<u>RBE</u>	<u>LOCATION</u>
X RAYS	0	1	VAB, SPE AND IN THE SECONDARIES MADE BY NUCLEAR REACTIONS, AND BY STOPPING ELECTRONS.
GAMMA RAYS	0	1	
ELECTRONS			
1.0 MeV	1	1	VAB
0.1 MeV	1	1.08	
PROTONS			
100.0 MeV	1	1-2	GCR, VAB, SPE
1.5 MeV	1	8.5 ?	
0.1 MeV	1	10 ?	

# IONIZING RADIATION IN SPACE (cont'd)

<u>NAME</u>	<u>CHARGE (Z)</u>	<u>RBE</u>	<u>LOCATION</u>
NEUTRONS			PRODUCED BY NUCLEAR INTERACTIONS FROM ABOVE.
0.05 eV (thermal)	0	2.8	
0.0001 MeV	0	2.2	
0.005 MeV	0	2.4	
0.02 MeV	0	5	
0.5 MeV	0	10.2 ?	
1.0 MeV	0	10.5 ?	
10.0 MeV	0	6.5 ?	
ALPHA PARTICLES			GCR
5.0 MeV	2	15	
1.0 MeV	2	20	
HEAVY PRIMARIES	≥3		? GCR

# **SCENARIOS**

---

- ACUTE EFFECTS
- SHORT TERM
- LONG TERM

# **SPACE ADAPTATION SYNDROME**

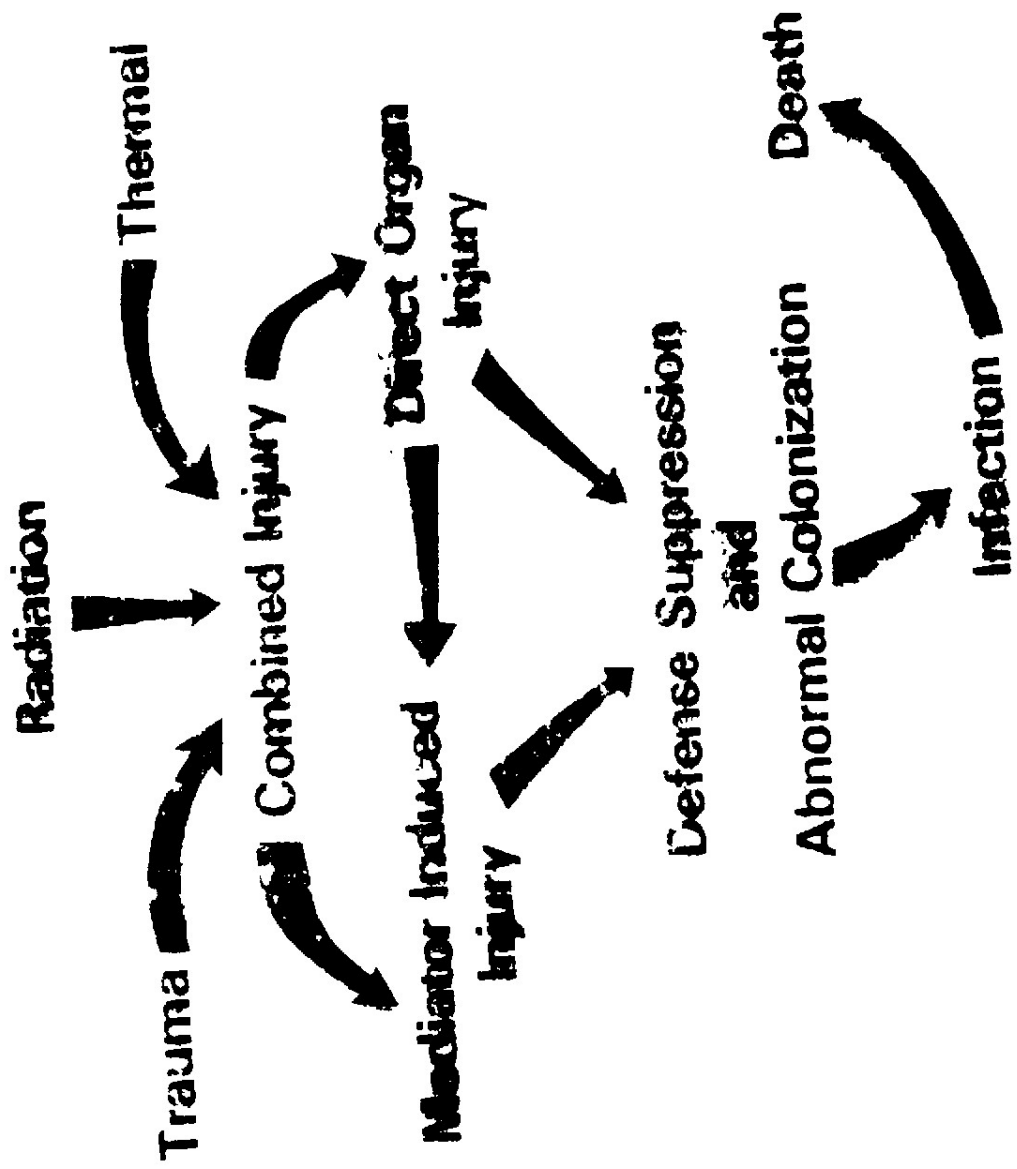
---

(SAS)

# **SPECIAL PROBLEMS**

---

- SAS + TBI
- HYPOCALCEMIA
- WR 2721
  - TOXICITY
  - PTH INHIBITION



# **RADIATION PROTECTION**

---

- **HOLISTICS**
- **ANY TECHNIQUES(S) INCREASES  
SURVIVAL OR ALLOWS  
RECOVERY OF SPACECRAFT**

# **PHYSICAL RADIOPROTECTION**

---

- SPACECRAFT
- STORM CELLAR
- GIRDLE OR GARMENTS
- G SUIT, MAST



# **BIOLOGICAL PROTECTION I**

---

- RADIOPROTECTION
- DIETARY ADJUVANTS
- ANTIEMETICS
- CIRCULATION SUPPORT
- EACA

# **BIOLOGICAL PROTECTION II**

---

- **MEDIATOR INHIBITION**
- **IMMUNE ENHANCEMENT**
- **SMALL WOUND**
- **SELECTIVE DECONTAMINATION**

# **BIOLOGICAL PROTECTION III**

---

- CELLULAR RECONSTITUTION
- AUTOLOGOUS BMT
  - SHORT TERM
  - LONG TERM

# **CURRENT PHARMACY**

---

- ANALGESICS
- ANTIHISTAMINES
- CHOLINERGICS
- ADRENERGICS
- STEROIDS
- ANTIBIOTICS